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AIR AND WATER CONVEYOR/COOLER FOR HOT LOOSE MATERIALS

The present invention is about an air and water conveyor/cooler for hot loose materials such as either heavy ashes generated by boilers, or ashes and slags produced in the various industrial processes like burning, baking, etc.

The innovative features, the objects and the advantages of the present invention will be understood in a not limiting way from the following description and from the annexed drawings relative to some embodiments wherein the different figures show:

Figure 1 is a lateral diagrammatic view of a conveying/cooling device according to the present invention for hot loose materials (3) coming from vacuum operated combustion chambers (2);

Figure 2 is a lateral diagrammatic view of a conveying/cooling device according to the present invention for hot loose materials (3) coming from pressure operated combustion chambers (7);

Figure 3 is a lateral diagrammatic view of a conveying/cooling device according to the present invention having the belt equipped with slots;

Figure 4 is a plan diagrammatic view of a conveying/cooling device of hot loose materials (3) according to the present invention;

Figure 5 is a diagrammatic view of the plano-volumetric arrangement of the nozzles (5) of the water sprinkling system in the small side panels (16) of the metal container (1);

Figure 6 is a diagrammatic view of the plano-volumetric arrangement of the nozzles (5) of the water sprinkling system in the upper cover of the metal container (1);

Figure 7 is a diagrammatic view of the weighing system (8) installed on the conveyor belt (4) for the capacity control;

Figure 8 is a diagrammatic detail of the strap iron (15) installed on the metal container (1) for the capacity control; and

Figure 9 is a diagrammatic view of the metal conveyor belt (4) having the plates equipped with slots (6).

It must be clarified on this matter that the same reference numbers in the various figures indicate similar or matching parts.

The conveyor/cooler according to the present invention uses for the transport of the hot loose materials (3), specifically such as heavy ashes and other combustion byproducts coming from the boilers or incinerators (2-7), a driving means with a steel metal belt (4) inserted in a sealed metal container (1).

The hot loose material (3) thanks to the gravitational effect leaves the boiler or incinerator (2-7) under which the metal conveyor belt (4) is found, whereon the material (3) is laid down by forming a continuous bed traveling towards the unloading area (9).

The dusty material with a smaller grain size which falls from the metal belt (4) and is laid down on the bottom of the container (1) is conveyed towards the outlet (9) through the use of a scraping conveying means (10) with chains or with a metal net.

The speed of the conveyor belt (4) can be adjusted with respect to the capacity of the conveyed material (3) and of the specific cooling needs, so as to optimize the distribution of the ashes on the belt in order to increase the thermal exchange surface.

The cooling of the loose material (3) exiting from the combustion chambers at temperatures close to 800/900°C, takes place through the joint feeding of air flows and water jets atomized inside of the container (1).

The external air is took back in the metal container (1) through the air intakes by using the vacuum found in the combustion chamber when the conveying/cooling system is connected to vacuum operated boilers (2). In the event that the conveying/cooling system were to be installed downstream of the boilers or incinerators wherein the combustion occurs under pressure (7), the cooling air is induced inside of the metal container (1) with the aid of a forced ventilation system.

The air flow enters from the air intakes (12) and passes through the metal container (1) by heading against the stream with respect to the advancing of the hot material (3) conveyed by the metal belt (4) towards the unloading area (9).

In order to improve the efficiency of the cooling process, the metal plates of the conveyor belt (4) can be equipped with slots (6) through which the cooling air can reach the bottom of the traveling continuous bed and can flow inside the layer of the material (3). In such manner, in the metal container (1) additional air intakes

(11) are provided, whose placement is such to generate a further cooling flow, different from the previous one.

Regarding the second air flow sucked by the intakes (11), a part of it flows at the bottom of the container (1) underneath the conveyor belt (4) towards the unloading area (9) where is mixed to the first flow coming from the air intakes (12), while the remaining part flows through the slots (6) made in the metal plates of the conveyor belt (4). By taking advantage of the difference in pressure existing between the upper section of the conveyor belt and the lower one, the air passes through the whole thickness of the traveling continuous bed of hot material (3), by cooling its bottom and the inner layer.

The geometry, the number and the arrangement of the slots (6) made in the plates of the conveyor belt (4) are defined as a function of the chemical-physical features of the conveyed material (3) and of the desired cooling degree, so as to avoid a possible leakage.

The fraction of used air for the two cooling portions of the incoming flow from the intake valves (11) can be measured through an adjustment mechanism (13) placed in the lower part of the metal container (1) in proximity of the unloading area (9).

The capacity of the cooling air is a function of the air intakes (11-12) and of the pressure difference established in the metal container (1), and it can be measured out by acting on the adjustment members of the intake valves.

The air absorbs the heat that the hot material (3) gives up thanks to the convective thermal exchange that the air directly has with the same material, with the walls of the metal container (1) which are radiatively heated, with the metal belt (4), both in its forward run and its return run, and at last through the possible post-combustion of the unburnt matter found in the conveyed material (3). It is convenient to clarify that in the specific case the metal conveyor belt (4) operates as a regenerative heat exchanger, by absorbing the heat from the hot loose material (3) in the forward run and by giving it up to the cooling air during the return run.

When the conveyor/cooler is applied to the boilers or vacuum operated incinerators (2), the air thus heated is taken back in the combustion chamber where is mixed with the main combustion air, by recovering in such manner part of

the thermal energy accumulated during the cooling phase of the hot material (3). When instead the system is applied to pressure operated combustion chambers (7) the air is directly ejected into the atmosphere, after an appropriate filtering for the recovery of the volatile substances.

In order to further reduce the temperature of the hot material (3) conveyed by the metal belt (4) the air cooling system is integrated with the water cooling system.

The water cooling system is made of a determined number of nozzles (5) which can be activated when the air only cooling capacity is not enough to guarantee the desired thermal reduction. The nozzles (5) are arranged in such manner that the atomized water jets would be directed on the upper part of the hot loose material (3) conveyed by the metal belt (4) during the forward run towards the unloading area (9).

The integration of the atomized water sprinkling system allows increasing the thermal exchange with the conveyed material (3), therefore it is possible to reduce the horizontal dimensions of the metal container (1) compared to the cooling carried out with air only.

The sprinkling system can also be used in the applications wherein the object is not just that of reducing the temperature of the conveyed material (3), but it is also that of achieving a preset moisturizing of the same material.

The number of nozzles (5) therein, their plano-volumetric arrangement inside of the metal container (1) and the kind of each single nozzle (5) are predefined according to the chemical-physical characteristics of the conveyed material (3), according to the capacity of the same material and according to the desired cooling degree.

The sprinkling system can be connected to the compressed air network so as to jointly atomize water and air with respect to the need to optimize the cooling by appropriately measuring out the capacity of the two elements.

The capacity of the nozzles (5), the intervention sequence and the duration of the activation are defined according to the temperature of the material (3) and according to the level of the capacity of the same material, through the on-line processing of the signals received by the temperature sensors (14) installed inside the metal container (1), and by the value of the capacity of the material (3).

The instant value of the capacity of the hot loose conveyed material (3) can be measured by either utilizing a weighing system (8) directly connected to the conveyor belt (4), or by using a strap iron (15) hinged to the upper cover of the metal container (1) suitable to detect the height of the layer of the conveyed material (3).

It is obvious that several modifications, adjustments, additions, variations and substitutions of the elements with others which are functionally equivalent can be made to the embodiments of the invention described in an explanatory but not limiting way without falling out of the scope of protection recited by the following claims.